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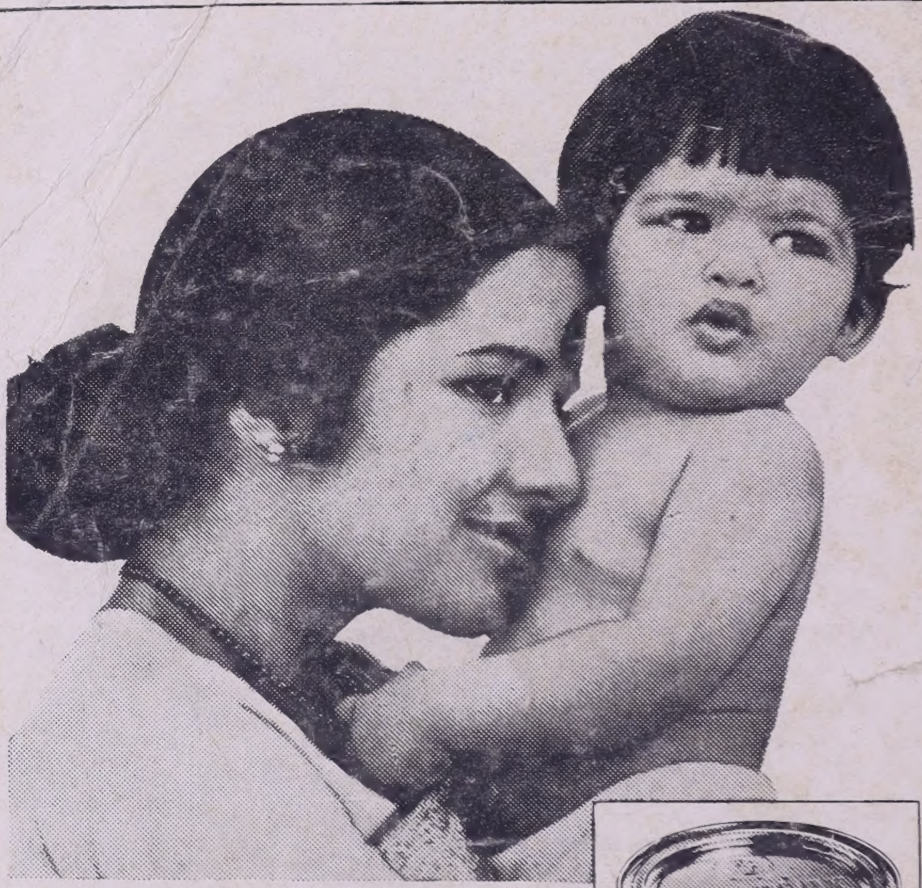

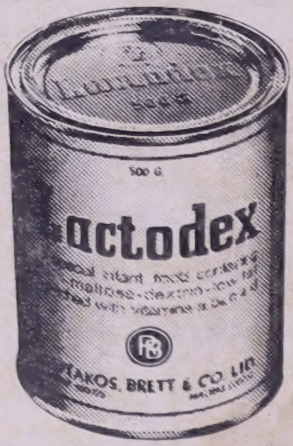

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QUARTERLY
MEDICAL REVIEW

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CHILDHOOD TUBERCULOSIS

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INTRODUCTION[1-4]

Tuberculosis is a specific communicable disease caused by Mycobacterium tuberculosis. It affects both the pulmonary and the non-pulmonary tissues. The disease may be acute or chronic, general or local, primary or secondary. It is usual to call the disease in children as primary and that in adults as post-primary or secondary. However, this is not entirely correct. Basically, in the first exposure or primary infection, bacilli are taken to regional lymph nodes which become the site of main activity in the primary tuberculosis. This is because of the fact that the hypersensitivity to tuberculoproteins is absent in the first 6-12 weeks after the primary infection, which is the time taken for the hypersensitivity to develop. The basic lesions formed during the primary infection, namely the Ghon's focus, the lymphangitis and the lymphadenitis, may continue to progress, leading to complications. The term "progressive primary disease" is suitable for this phase.

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In all subsequent exposures or secondary infections, also called supra-infections, the bacilli are limited at the side of entry due to the hypersensitivity reaction (type IV) or the cell-mediated immunity. The lesion progresses through the stages of cellular infiltration, granuloma formation, caseation and cavitation, and the term "secondary tuberculosis" is suitable for this. Clinically, silent foci formed by bacillaemia during the primary or the secondary infection, and other quiescent foci may get reactivated and progress any time subsequently during the childhood or later. Secondary tuberculosis is an appropriate term here also. Here, this is describing the phase of tuberculosis after the activity of lesions of primary or secondary infection was quiescent for some time. Some use the term post-primary tuberculosis for all active tuberculosis that presents one or two years after the primary infection.

The terms "childhood tuberculosis" and "adult-type tuberculosis" are not synonyms for primary and secondary tuberculosis. Primary infection, secondary infection, reactivation and flaring up can occur in children as well as in adults. This depends on the prevalance of 'open' or infective cases in a community. The primary complex (PC) and its complications as well as the secondary infection with cavitation and late complications like renal and skeletal tuberculosis are seen in children in developing countries, including India, where infection is acquired early in life. On the other hand, primary tuberculosis is sometimes observed in exposed adults in the west, who do not get exposed to infection or BCG during childhood.

MICROBIOLOGY[4-6]

The causative agent of tuberculosis is Mycobacterium tuberculosis. Mycobacteria are acid fast, gram-positive, non-motile, non-capsulated, non-spore-forming aerobic rods. Most of these are slow-growing bacilli. Mycobacterium tuberculosis is the most important pathogen in humans.

It can survive for several weeks in dry sputum and other excreta. It is inactivated by ultraviolet light and sun's rays, if temperature is above 60°C. M. bovis is M. tuberculosis-like organism noted primarily as a bovine pathogen. However, human infections with M. bovis were not uncommon a few decades back. Today, the incidence of infection with M. bovis has decreased to an insignificant level all over

the world including India. M.marinum and M.avium, primary pathogens of salt water fish and birds, can occasionally cause infection in the human.

Infections due to other mycobacteria are presently getting increasing recognition. It's incidence in children in India is not known but may be significant. In our hospital laboratory's acid fast bacilli (AFB) cultures, 15% are recognised as atypical mycobacteria. Chief among these are M.kansasi, M.scrofulaceum and M.simiae. Atypical mycobacteria are classified according to their property of pigment production, speed of growth and other biochemical properties.

Atypical mycobacteriosis should be distinguished from tuberculosis. The clinical features may be similar but tuberculin hypersensitivity is of low degree. Most of these atypical mycobacteria are resistant to commonly used antitubercular drugs including isoniazid (INH), rifampicin and streptomycin, Cultural diagnosis is therefore important.

Some mycobacteria like M.phlei and M.smegmatis are non-pathogenic. It may, therefore, be occasionally wrong to base the diagnosis solely on AFB demonstration on smear examination by microscopy. Culture will help in differentiating tuberculosis organisms from non-pathogenic mycobacteria and from atypical mycobacteria. Further, culture and sensitivity will determine the susceptibility patterns of these mycobacteria. This is becoming important with the emerging problem of resistant strains of M.tuberculosis.

PATHOGENESIS AND PATHOLOGY [4-7]

The source of infection is usually an open case of tuberculosis in the family or neighbourhood, who through cough disseminates bacilli in the environment (droplet infection). Unboiled milk from cattle having tuberculosis of udder, draining sinuses and infected article or equipments (e.g. injection needle) are unusual sources.

In over 95% of cases, the site of entry is through the lung. Uncommonly, it is intestine or tonsils and rarely skin or conjunctiva.

At the site of entry, the bacilli are initially surrounded by polymorphonuclear cells which are soon replaced by lymphocytes and macrophages. Macrophages carry the organisms to the regional lymph node via the lymphatics. Bacilli are also carried to the neigh-

bouring nodes which also enlarge. Intermittently, bacilli enter the blood stream and are thus scattered throughout the body. These seedings may become the sites of future tuberculoma formation.

By now, in 6-12 weeks, hypersensitivity to tuberculoproteins has developed and further spread of bacilli is limited by lymphocytic and plasma cells infiltrations around the lesions. Small lesions with few bacilli totally clear in due course of time. Some lesions heal by fibrosis or calcification. The initial lesion at the site of entry is called the primary focus (Ghon's focus). The primary focus is usually subpleural and single. This becomes visible in X-ray of chest against the air contrast. The draining lymphatics may become visible as streaks and the draining nodes can also be identified. The primary focus, the lymphatics and the enlarged draining nodes together are called the primary complex.

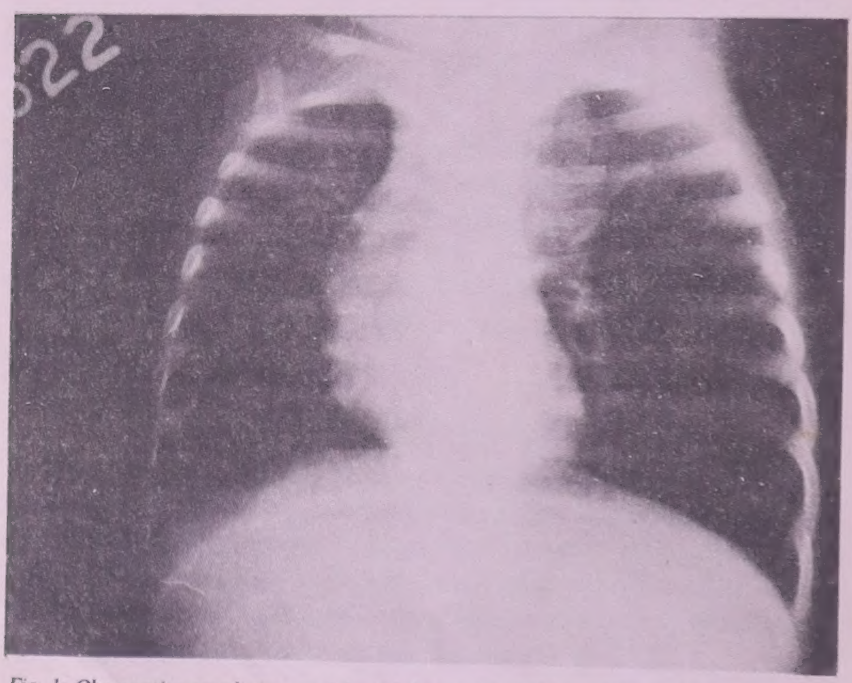

Fig. 1: Obstructive emphysema of the left lung with shifting of the mediastinum to the right is clearly visible. There is a large node or a bunch of nodes in the left paractracheal area compressing & shifting the left bronchus to the right and downwards. Strongly positive tuberculin test in this six-month-old girl confirms the diagnosis of tuberculosis. She improved with antituberculosis therapy. Overinvestigation, bronchoscopy or operative intervention was thus avoided.

When the host resistance is poor and the load of bacilli greater, the lesions do not heal but continue to progress. The progression usually involves the nodes but it can occur in the primary focus or at any other place where the bacilli are seeded. The draining lymph node enlarges and a granuloma forms. The granuloma is a collection of lymphoid and plasma cells and epithelioid and giant cells surrounded by fibrosis. This gradually necroses in the centre (caseation).

An enlarged node may compress the adjacent structures. In the pulmonary primary complex (PPC), the bronchi are obstructed and obstructive emphysema (Fig. 1) or collapse of a segment or a lobe follows. The air tubes may be eroded and the caseous material may be aspirated leading to consolidation or bronchopneumonia. The middle lobe bronchus is thus frequently involved and middle lobe syndrome (collapse consolidation) is quite typical of the progressive pulmonary disease (PPD).

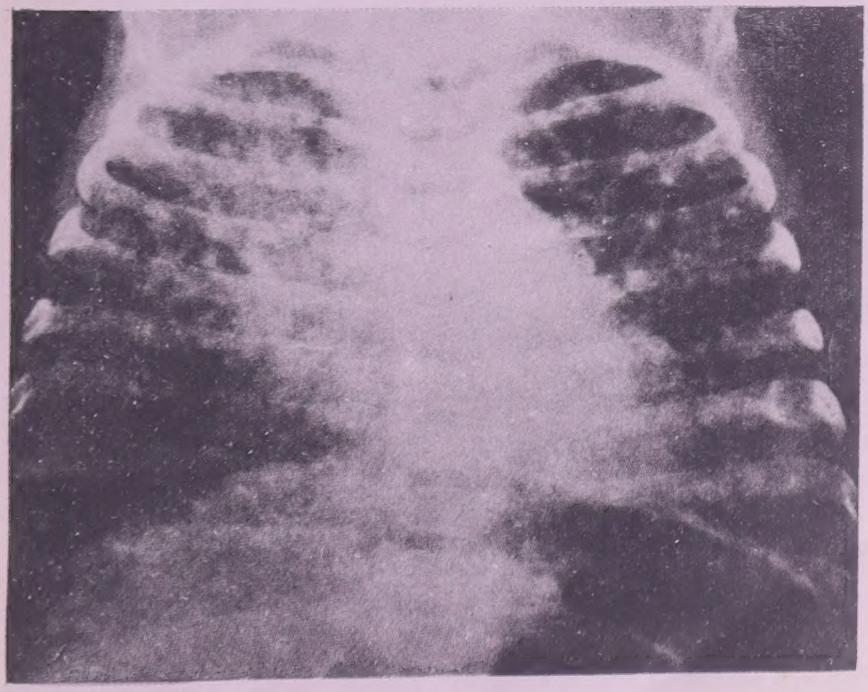

Fig. 2: Miliary tuberculosis may show on X-ray chest as snowy appearance, or as more clear miliary shadows spreading up to peripheral lung areas or as even 'harder' well-circumscribed miliary nodules. This X-ray belongs to a 4-month-old girl.

Bacilli may be discharged into the blood stream from a caseating node either by erosion of a vessel or more commonly by lymphatic drainage. The dissemination may be acute or intermittent or protracted. This leads to miliary tuberculosis with the formation of minute tubercles in various organs of the body. These tubercles are visible in X-ray chest as miliary shadows (Fig. 2), or in the choroid at fundus examination or in the skin. When meninges are thus involved, tuberculous meningitis occurs.

Occassionally, a primary focus may progress and effusion may follow (Fig.3). Cavity formation is rare in primary focus or in the lung parenchyma otherwise involved in PPD (cavitating primary).

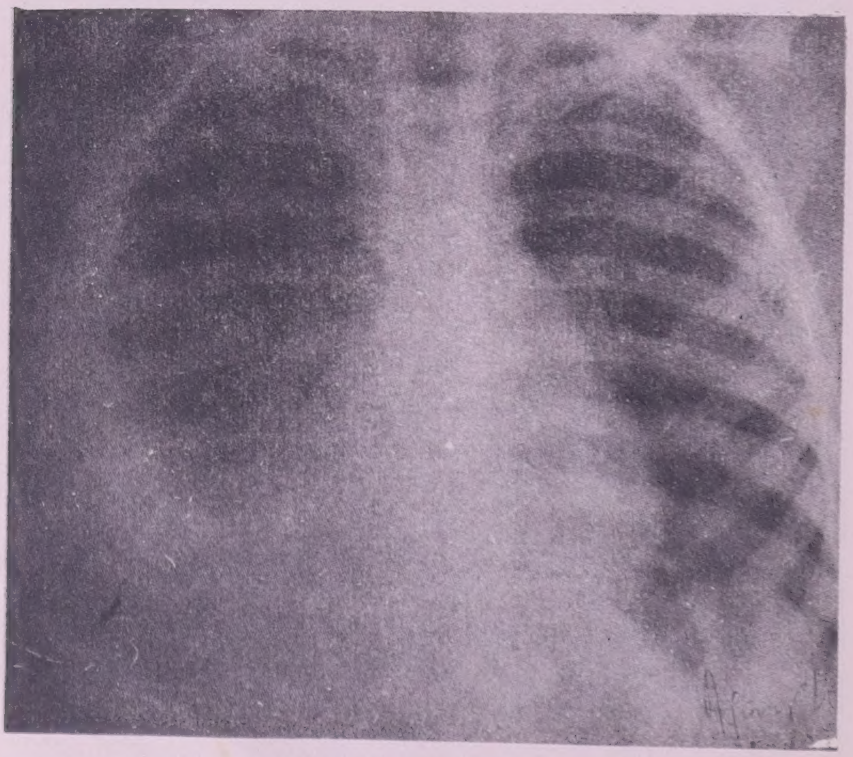

Fig. 3: Pleural effusion and underlying consolidation due to tuberculosis in a 7 year-old; cleared totally with therapy. The D/D should include viral and pyogenic effusions.

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When the disease involves cervical lymph nodes, they enlarge, matt and get fixed to the skin, and may discharge caseous material and pus through a sinus.

In abdomen, these nodes may compress adjacent structures like the bile duct or the portal vein or it may cause ascitis or peritonitis by rupturing into the peritoneal cavity.

Many times, matastatic foci, formed by the haematogenous spread, progress. The pathological process of granuloma formation and caseation is similar. These granulomas are called tuberculoma. When these involve the brain, they commonly present as intracranial space-occupying lesion, hydrocephalus or as tuberculous meningitis (TBM) following rupture into CSF.

When vertebrae are involved, they collapse due to destruction, and pressure over the spinal cord may result in paraplegia. The distorted vertebra may become prominent as gibbus due to angulation. Caseous material or pus from the vertebra sometimes tracks along the fascial spaces by gravity. These cold abscesses in turn may cause compression of adjacent structures.

The 'healed' lesion may harbour live bacilli for years and be the seat of disease subsequently. It is possible that the 'adult' or 'reinfection' tuberculosis is, in many cases, actually due to reactivation of an old focus (endogenous reinfection).

CLINICAL FEATURES[1-4]

The clinical features vary greatly, depending on many factors like age and resistance of the host, dose and virulence of the organism, severity of the disease and the site of infection (Table 1).

General features: Pyrexia — low grade, moderate, recurrent or prolonged — is common. Typical evening rise with night sweating is occasionally seen. Appetite is lost and actual decrease in weight may occur. Anaemia, generalised lymphadenopathy and mild hepatosplenomegaly may be observed. Mild clubbing occurs in advanced pulmonary tuberculosis. A history of contact will be obtained in about 20% of cases.

1. *Pulmonary tuberculosis:-* Cough is a prominent feature. It may be intermittent or persistent but is never severe. It is dry, occasionally brassy, when nodes are pressing over respiratory passage. Rarely, it is productive in older children who have advanced disease.

Table I

Characteristics of primary and post-primary or secondary tuberculous infection in man

	Primary infection	Post-primary or secondary infection
1 Synonyms	First infection, primary tuberculosis.	Reinfection, suprainfection, secondary tuberculosis.
2 Usual age	Young children, older children & adolescents.	Adults, old & adolescents.
3 Basic differences	(a) Due to absence of delayed hypersensitivity reaction during first 6-12 weeks, tubercular bacilli are taken from the portal of entry to the regional lymph nodes where they multiply.	Due to presence of delayed hypersensitivity reaction, bacilli are limited to the site of entry where they multiply.
	(b) Haematogenous seeding carrying the organisms throughout the body occurs.	Seeding uncommon.
4 Main site of progressive lesion	Regional lymph nodes-pulmonary, intestinal, cervical etc., leading to caseation & discharge into neighbouring structures.	Site of entry lung tissue,intestinal mucosa & wall, leading to caseation, cavitation and cicatrization.
5 Common complications	(a) Bronchial obstructions (atelectasis, emphysema) due to external pressure from node; (b) Consolidation, bronchopneumonia due to discharge of caseous material into bronchus; (c) Miliary tuberculosis and tubercular meningitis due to haematogenous spread.	Pulmonary cavitation,fibrosis, skeletal and renal tuberculosis, Koch's abdomen.
6 Infectivity	Low or absent, unless main lesion communicates with bronchus	High as main lesion usually communicates with bronchus discharging bacilli in the sputum.
7 Bacterial load	Comparatively low.	High.
8 Resistant strains	Rare to uncommon.	Not uncommon, always a cause of concern.
9 Healing	By fibrosis or calcification	By fibrosis & cavitation usually.
10 Reactivation (also called endogenous reinfection or exacerbation)	Following measles, whooping cough, malnutrition, cortisone therapy.	Following diabetes, immuno-suppressive therapy, and malnutrition or early stoppage or poor compliance of therapy.
11 Prevention by BCG	To some extent; specially prevents complications like miliary spread & TBM.	None.

Wheezing is unusual; so is respiratory distress. The chest is devoid of signs unless bronchi are eroded or obstructed or complications occur. In these cases, various signs will be obtained depending on the pathology — effusion, obstructive emphysema, consolidation, pneumonia or rarely, a cavity. When carinal or hilar glands are markedly enlarged, bronchial breathing is transmitted from bronchi or trachea to the posterior chest wall from below T_4 to T_{7-8} around the mid-line.

Uncomplicated primary pulmonary turberculosis heals in the majority of cases even without treatment. Complications can be prevented by therapy (secondary chemoprophylaxis). Complications, when they do occur, occur within 2 years, usually within 1 yr. after acquiring the primary complex. The majority of pulomonary complications are totally curable with proper therapy. Only rarely, sequelae like bronchiectasis, bronchial scarring and erosion or cavity are left.

Tuberculous bronchopneumonia and miliary tuberculosis are very serious complications and are usually observed in malnourished infants and young children who have suffered some prolonged illness like measles, whooping cough, diarhoea etc. recently. These kids are marasmic, prostrated, toxic, pale and frequently have high spiky fever and altered sensorium. Cough may be absent due to prostration. Usually, cough is mild to moderate with mild to severe respiratory distress and few chest signs. X-ray chest is the most important investigation here. It will turn out that most of these children have not received BCG. Prognosis is poor in these cases. However, after the acute stage has passed, complete recovery can be expected.

Differential diagnosis in the early stages of PC includes various causes of prolonged pyrexia — recurrent respiratory infection, urinary infection, typhoid, malaria, leukaemia, rheumatic fever etc - and various causes of protracted and recurrent cough - recurrent viral respiratory infection, tonsillopharyngitis, respirtory foreign body, asthma, whooping cough, chronic bronchitis, bronchiectasis, cystic fibrosis and so on. When effusion, consolidation or bronchopneumonia are demonstrated, viral or pyogenic aetiology needs to be excluded. Foreign body of the respiratory tract is a common cause of obstructive emphysema. The differential diagnosis of hilar or paratracheal enlarged node of mass includes not only other causes of lymph node enlargement but also thymus, congenital cysts and tumours, and benign and malignant lymphatic tumours.

When miliary shadows are demonstrated on X-rays, bronchopneumonia, tropical eosinophilia, pneumoconiosis, sarcoidosis and histiocytosis need to be considered

2. *CNS tuberculosis*: The classical common presentations are of meningitis, encephalopathy or encephalitis, intracranial space-occupying lesion (tuberculoma) and Pott's spine.

Those who present with meningitis or encephalopathy are frequently young children who have had general symptoms like fever and not being well for 2 weeks or more. This is followed by recurrent vomiting, irritability and headache. Many of these children are brought subsequently, when they throw a convulsion or develop altered sensorium or unconsciousness. The signs of meningeal irritation (neck rigidity, Brudzinski's sign and Kernig's sign) will be mostly present in meningitis and will be absent in encephalitis. Monoplegia, hemiplegia and isolated cranial nerve palsies occur in both. The child may be deeply comatose or go in decerebrate rigidity repeatedly, either spontaneously or on stimulation by supraorbital pressure. This is due to diffuse cerebral oedema and raised intracranial tension. Papilloedema is not demonstrated early in the course and choroidal tubercles are rarely seen.

Associated hydrocephalus is common and should be suspected in the presence of signs of raised intracranial tension, enlargement of head, papilloedema, occular palsies or separation of sutures. CT scan or air or dye ventriculography is required to prove the diagnosis. A temporary or permanent ventriculoatrial or ventriculoperitoneal shunt will be required to prevent optic atrophy and other complications.

About 30% of these children die during the acute stage or subsequently in spite of therapy due to complications like aspiration, coning, inanition and secondary infection. About 40% survive with serious disabilities like mental retardation, epilepsy, optic atrophy and various motor palsies. Surprisingly, complete or near complete recoveries are occassionally seen in kids who have been comatose for days, and, therefore, hope should not be lost, although, false hopes should not be offered Prognosis is good in children who do not have convulsion or unconsciousness and who receive early therapy.

CSF examination will confirm the presence of meningitis. However findings of mild-to-moderate rise in proteins, pleocytosis

with lymphocytic preponderance and a normal CSF sugar level can be simulated by partially treated pyogenic meningitis and viral meningitis. Tuberculous encephalopathy needs to be differentiated from viral encephalitis. The short or prolonged duration of symptoms, the history of contact, or PC or recent measles, or whooping cough, evidence of other tests, the course of illness and sometimes the response to therapy are all required to be evaluated for correct diagnosis. It is only rarely that the diagnosis cannot be made or ruled out with certainty.

Persistent or increasing symptoms of headache and vomiting, specially in the morning, should not be taken lightly. Soon diplopia, vision difficulty, squint, focal convulsion or focal palsy, ataxia, tremors or other cerebellar signs may point to the presence of a space-occupying lesion. Most tuberculomas are cerebral or cerebellar and are 1 to 3 in number. When multiple, they vary in size. Uncommonly, they are so strategically situated near the aqueduct or fourth ventricle that these cases present as hydrocephalus. Calcification is rarely demonstrated on X-rays but CT scan can pick up the tuberculomas easily (Fig. 4).

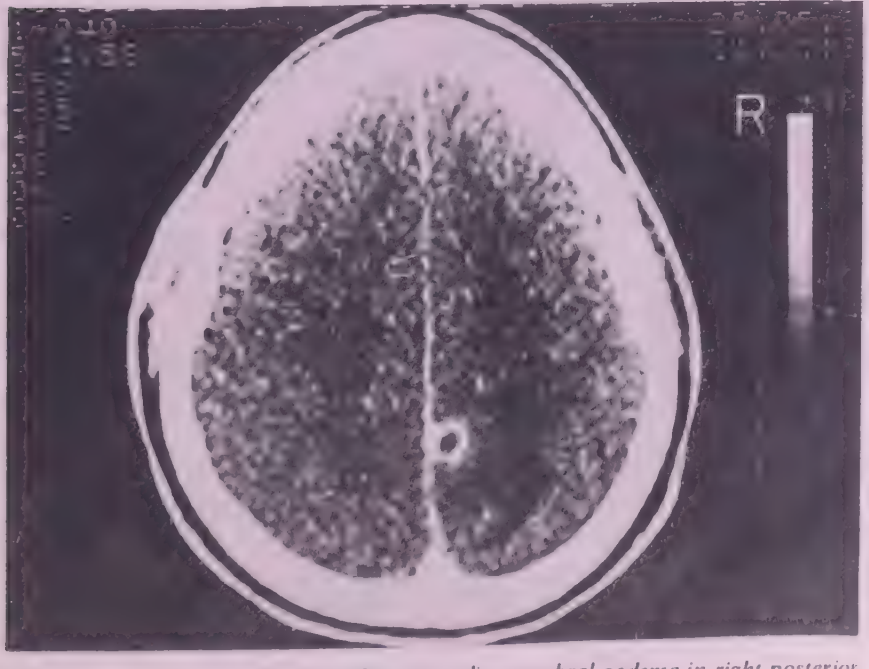

Fig. 4: Ring enhancing lesion with surrounding cerebral oedema in right posterior parasagittal region diagnoses tuberculoma.

The differential diagnosis includes benign and malignant tumours and cysts. Tuberculomas are treatable and regress with therapy. Epilepsy, palsy or mental retardation may, however, remain.

3. *Abdominal tuberculosis* presents in many ways. Rural children are more commonly affected. Presentation usually occurs after 7 years of age.

Ascitic form is a kind of tuberculous peritonitis. Massive ascitis is in striking contrast with rather typical tuberculous physique and look. These children are thin-built, having little muscle mass and absent subcutaneous fat. The skin stretches over bony prominences, specially the facial bones. Eyes are sunken, face is drawn, and there is a typical hungry, distressed look.

'Plastic' form of Koch's abdomen is suspected in a child who has gastrointestinal symptoms and the typical doughy feel on palpation of the abdomen. This feel is due to diffuse peritonitis with thickening and adhesions of omenti, mesentery and visceral and perietal peritoneum. These tend to bind intestinal loops and other organs to one another. Recurrent diarrhoea, alternate diarrhoea and constipation, chronic abdominal pain and subacute intestinal obstruction are usual manifestations.

Tuberculous mesenteric and other lymphadenitis of abdomen presents with pain, lumps or symptoms of pressure or obstruction of neighbouring structures. These nodes are multiple, many times matted and are palpated as mobile, firm, nodular mass or masses. Obstruction of biliary duct, portal tract, pancreatic duct, duodenum, inferior vena cava, ureter etc. is more often suspected to be due to a node than actually proved. Excisional biopsy is many times required for diagnosis and to rule out more serious forms of lumps.

Ulcerative enteritis and granulomatous thickening resembling Crohn's disease are other ways of presentation.

Isolated tuberculosis of stomach, duodenum, pancreas, spleen, adrenals and liver is rare. The liver is supposed to be frequently affected in disseminated tuberculosis, although the histology many times fails to demonstrate tuberculoma or tubercles in the biopsied piece.

Recovery is practically complete with therapy. However, sequelae like subacute intestinal obstruction, female infertility from

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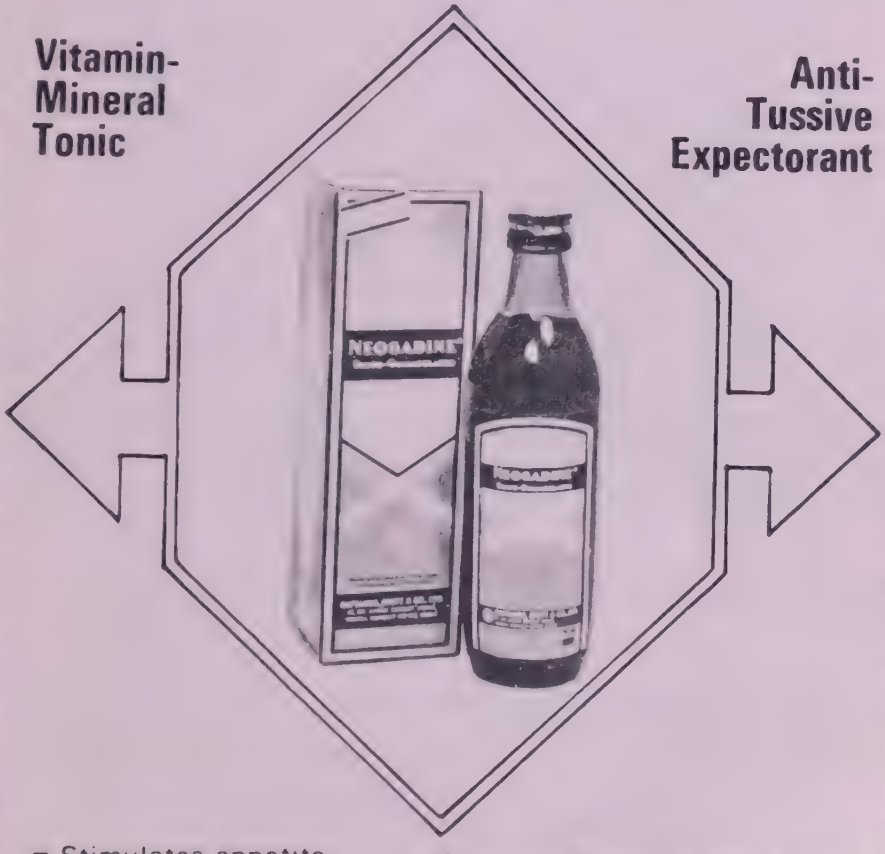

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tubal block, addison's disease, diabetes, sexual infantilism and oligomenorrhoea from disease of adrenals, pancreas or ovaries respectively, may occur and tuberculosis is included in the differential diagnosis of these clinical situations.

4. *Genitourinary tuberculosis* occurs by haematogenous spread and it usually manifests 3-10 years after the primary infection. Bacilli settle close to the glomerulus and tubercles form. These may gradually enlarge to reach the renal papillae which are destroyed. Typical ulcerocavernous lesions are formed which discharge bacilli in the urine. The involvement of bladder and ureter is, therefore, secondary to renal tuberculosis.

This manifests with frequency of micturition, and many times with haematuria, in children who usually are above 10 years of age. Urine examination may demonstrate RBC's and many times plenty of pus cells. Routine urine cultures are sterile (aseptic pyuria) but cultures for mycobacterium are frequently positive. Intravenous pyelography may demonstrate caliceal deformity, calcification, cavitation and ureteric stricture.

Sex organs like epididymis, testes, ovaries, fallopian tubes, breast tissue and uterus are rarely the sites of infection in pubertal or adolescent children.

5. *Skeletal tuberculosis*:- The bones and joints are infected secondarily, usually by the haematogenous route. Dark-skinned races appear to be particularly susceptible. Usually, the involvement is monoarticular, but multiple cystic skeletal lesions may occur in protracted haematogenous dissemination. Spine, hip, knee, angle, tarsus, shoulder, elbow and other joints and bones are affected in that order. Vertebral involvement is rare below 2 years. Sacroiliac joint is also rarely involved in children. Dactilitis, involvement of long bones of hand and foot, formerly common in infants, is now rare. The involvement may be primarily granular — mild, nondestructive but fibrosing or exudative — destructive, abscess-forming and caseous. Joint affection is secondary to an osseous lesion in children with rather rapid destruction of the joint, while in adults the synovium is affected first, where the disease remains confined for a long time. The articular disease passes through three states — synovitis, arthritis and destruction.

Early specific symptoms include dull, aching pain, night cry, limping, doughy swelling, tenderness and slight warmth of the joint.

In late stages, prominent joint swelling, fibrous ankylosis, muscle wasting, shortening of the limb and deformity are seen. Radiologically, osteoporosis around the affected joint is the first sign. Soft tissue swelling, periosteal reaction, reduction of the joint space, destruction of articular surface etc. are demonstrated later depending on the stage of disease.

In Pott's spine in children, the disease is metaphyseal, secondarily involving an intervertebral disc. So, there is rapid narrowing of the disc space. In adults, the vertebral body is primarily involved. Thoracic, lumbar and cervical vertebrae are involved in that order. When a vertebra is involved, it frequently collapses leading to pressure over the spinal cord or its roots. Cold abscess can also be seen radiologically as an oval soft tissue shadow around the destroyed vertebra.

Apart from the general and chemotherapeutic measures, immobilization of the part by splinting or plaster is often required. Occasionally, surgery is required to relieve the pressure over spinal cord. Rarely, excision of the focus or a bone is necessary.

6. *Cervical tuberculous lymphadenitis* presents with enlarged lymph nodes. Initially, these are discrete and small, Gradually they enlarge and get matted. Soon, they fix to the skin and soften in consistency. Untreated, they progress to discharge the caseous material through the broken skin. This results in a chronically discharging sinus formation (scrofuloderma). The differential diagnosis includes lymphatic malignancy, atypical mycobacterioses and fungal infections, specially actinomycosis. With treatment, these nodes respond well leaving practically no sequelae except contracture at the site of sinus. Sinectomy may be required.

7. *Allergic manifestations* of tuberculous infection merit special mention.

Phlyctenular conjunctivitis or 'phlyctena' formation — an inflammatory reaction of scleral conjunctiva at either angle of the eye with membrane formation — is considered typical of active tuberculous infection.

Erythema nodosum — formation of red indurated round 1-13 cm diameter-sized areas in the skin, specially at the shins — is a nonspecific, allergic reaction and can occur with tuberculosis,

streptococcal infection, drug or other allergen exposure. These nodules come and go over a few weeks. Search should be made for an active tuberculous focus.

Serous meningitis or Lincoln's meningitis is an allergic reaction of meninges to tuberculoproteins, although, rarely, bacilli can be demonstrated in the CSF. Pleural or pericardial effusion is also considered an allergic manifestation by some. A protracted or

Fig. 5: This 2 year-old male child presented with noisy breathing. The film shows destruction of cervical and greatly increased prevertebral space. This suggests a cold abscess formation which is pressing over the trachea. 20 cc of caseous material, positive for AFB, was aspirated. Tuberculin test was strongly positive. Child improved with anti-tubercular therapy.

recurrent arthropathy with pain and mild swelling of multiple joints fall in the same group. In all these cases, marked hypersensitivity to tuberculoproteins should be demonstrated by appropriate tests. As these usually indicate the presence of an active disease, antitubercular therapy is indicated and is helpful. Cortisone may be used for a short period in massive pleural or pericardial effusion.

8. *'Cold' abscess* which contains caseous or purulent material, is so called because the classical signs of inflammation, namely, redness, heat, oedema and pain are absent. A fluctuant cold swelling at an odd site like thigh, groin, axilla, neck or back is present. In most cases, it is discovered that the purulent caseous material has travelled down along fascial lines from some destroyed vertebra. When it presents near the surface, diagnosis is easy. However, it may remain deep or internal and press over oesophagus, trachea, nerves, bladder, ureter or any other organ (Fig. 5). It may erode these organs and discharge ceseous material into them.

DIAGNOSIS [4,5, 8-11]

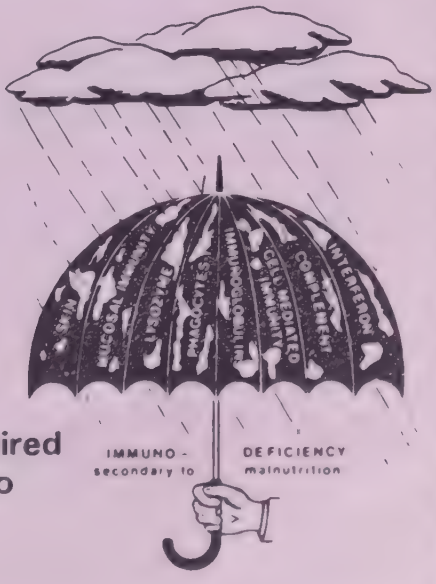
When tuberculosis is suspected from history and examination, the diagnosis can be confirmed or ruled out by a number of available tests.

Demonstration of hypersensitivity to tuberculoproteins (Intradermal tests):— This is a very important test, used in most circumstances. Many intradermal tests are available and a person should be familiar with the proper technique and interpretation of the test being used. Mantoux test, which is the most frequently used and the most satisfactory test, will be described here in detail.

Mantoux test (MT): 5 tuberculin units (TU) of purified protein derivative (PPD) in 1 ml. is injected intradermally in the forearm by a sterile tuberculin syringe and a 26 No, needle. 5 TU has been found to distinguish the infected and the uninfected persons most effectively. A wheal of about 5 mm is thus raised. The area is marked and reading is taken after 48 to 72 hours. Induration (and not only erythema), which can be seen and palpated, is measured in millimeters, transverse to the forearm. An induration of up to 5 mm is a negative test, of 6-9 mm is a borderline test and of 10 mm or more is a positive test. In strongly positive tests, much larger induration of 15-30 mm is seen. In these cases, blistering can also occur.

A concert of non-specific barriers and antigen-specific immune responses normally protect man from extraneous and internal injurious agents.

Malnutrition robs the host of these defences.



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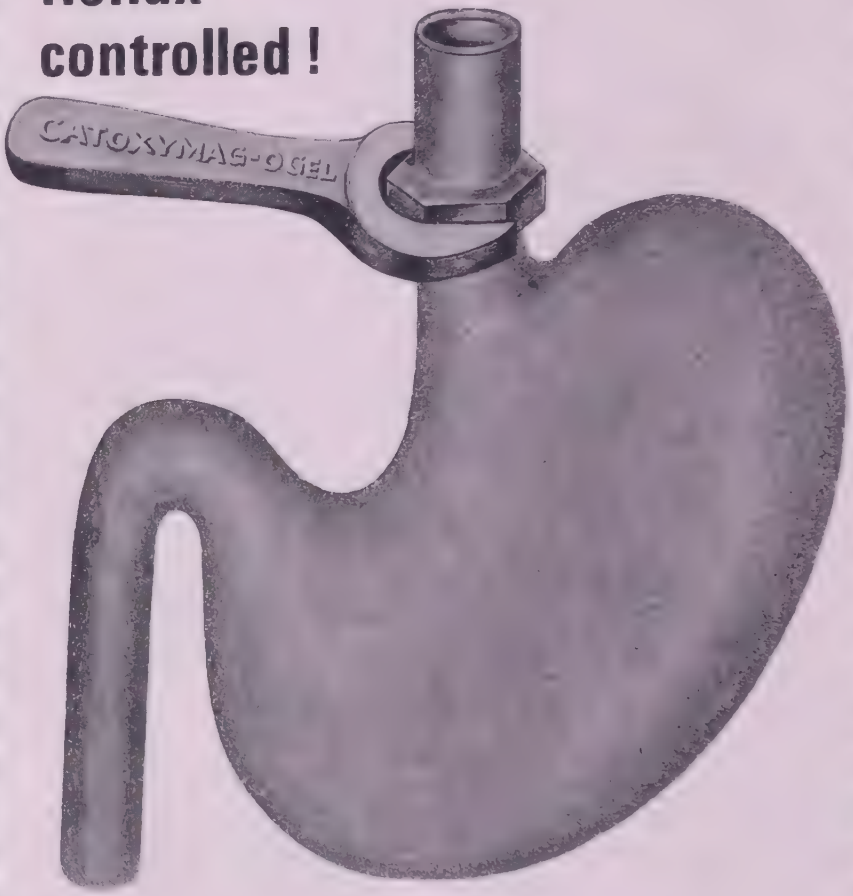

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Interpretation:- Induration of 0-5 mm — negative test:- (i) Child uninfected with tuberculosis; or (ii) recent infection of less than 4-12 weeks' duration (hypersensitivity has not yet developed); repeat test after 4-12 weeks may be done, if necessary; (iii) or anergy or loss of hypersensitivity due to malnutrition, an acute febrile illness, recent infection of measles or whooping cough, cortisone therapy, and use of cytotoxic drugs or radiation etc.; (iv) sometimes negative test occurs in overwhelming tuberculous disease, e.g. miliary tuberculosis, due to immunological tolerance from an excess of circulating antigen; (v) a faulty technique and use of outdated material must be ruled out before labelling a test as negative.

Induration of 6-9 mm — border line :- Repeat the test. If the reading is below 10 mm, the test is negative; if it is above 10 mm, the test is positive. Borderline test may also be due to atypical mycobacteriosis or prior BCG vaccination.

Induration of 10 mm and above — positive test:-

i) If the child is below 4-6 years of age, it may be assumed that the infection is recent and active and requires therapy.

ii) If child is above 6 years — either he has active infection (look for other evidence), or he had been infected with tuberculosis organism in the past (a significant finding in any case). BCG vaccination in last year and infection with atypical mycobacteria may also give a positive test of up to 15 mm induration.

The interpretation may seem complicated and confusing to the beginner, but the test is a very important tool in the hands of the experienced. It must be performed in all cases. While a negative test does not rule out tuberculosis (positivity or sensitivity varies from 40 to 80% in various studies), a positive test is a strong evidence of active, quiescent or past tuberculous infection.

BCG test: Due to a high prevalence of malnutrition and infections in our country, MT is frequently negative, despite active tuberculous infection. Most paediatricians in India will now do what is called the 'BCG test' before ruling out tuberculosis in a case. Here the test material is BCG vaccine itself and the technique is also as per BCG vaccination, i.e. 1 ml. of the prepared vaccine is injected intradermally in the deltoid region. Induration is read at 48-72 hours. If it is 5 mm or more, the test is considered positive; otherwise negative. Greater positivity of up to 95% is due to higher dose of

tuberculo-proteins — equivalent to 20-50 TU. There may be other reasons too[12]. The test is an advancement and should be done when MT is negative. Many paediatricians have recommended direct BCG test (or vaccination) without prior tuberculin test on the ground that if the test is negative, immunization will be achieved, and if positive, no harmful effects occur. Repeated BCG on a large scale may however invalidate future tuberculin tests.

Skiagrams (Fig. 1-6): X-ray of the chest is another important investigation that must always be done. It also requires considerable skill and experience in reading and interpretation.

Fig. 6: Calcified primary focus, lymphatics and regional nodes as seen here are also uncommon. The calcification may disappear with time in a few years.

All the three components of the primary complex are not commonly visualized; the lymphatics are rarely identified and the primary focus may also not be visible. The nodes appear as round shadows, sometimes calcified. Frequently, these shadows are mixed with hilar and mediastinal shadows and only the outer round border may be distinguished. Lateral and oblique views are useful in such cases. Carinal glands may be visible through the heart shadow and may cause widening of the carinal angle.

When there is progressive primary complex or pulmonary disease, other signs like collapse, consolidation, obstructive emphysema, pneumonia, effusion or rarely a cavity, will be seen. These are also very important findings for diagnosis. Miliary shadows may also be visible in miliary tuberculosis.

X-ray of the skull may show signs of raised intracranial tension, or calcification in presence of a tuberculoma. In bone and joint tuberculosis, destruction and collapse of the part will be demonstrated. Other X-rays may be utilized to show the effect of tuberculous infection on kidneys, genital tract, abdominal lymph nodes and so on.

CT Scan has been immensely useful in CNS tuberculosis. It may show oedema, infarction, basal exudates and fibrosis, obstructive hydrocephalus or a tuberculoma. The tuberculoma appears as a diffuse round homogeneous mass. More typical, almost diagnostic, is the ring shadow—large central hypodense area surrounded by a ring of high density. CT scan is also useful in differential diagnosis of mediastinal and abdominal masses, skeletal lesions and other local lesions. It is also useful in the follow-up.

Microbiological studies:- Effort should always be made to demonstrate and culture the organism from body excretions and tissues. Sputum, when available, is the best choice. However, as most children do not produce sputum, fluid obtained from gastric lavage done early in the morning is used. Laryngeal swab may be used. When bronchoscopy is done, bronchial secretions must be examined.

Other body excretions or fluids that are specially suitable include discharge from a sinus, aspirate from a cold abscess, pleural, peritoneal or joint fluid, CSF and urine depending on the site of tuberculous infection. Biopsied material may also be used for the purpose.

A negative test does not negate the diagnosis as the positivity in the best of the laboratories is only 40%. However, a positive test is diagnostic.

Improved methods have become available for demonstrating acid-fast bacilli (AFB). Fluorescent staining with auramine O and examination under a good fluorescent microscope is superior to the Ziehl-Neelsen's staining with regard to positivity, ease of detection and speed. Thin body fluids like CSF and urine should be centrifuged and the deposits examined. Repeated examination of samples increases the positivity.

The culture of M.tuberculosis is commonly done on the Lowenstein-Jensen's (LJ) egg medium. Newer media like the Dubos oleic acid-agar have also been introduced. The samples such as sputum, which contains a large number of bacterial contaminants, need to be decontaminated. In renal tuberculosis, the urine often contains very scanty tubercle bacilli and their excretion may be erratic. Centrifuged deposits of 5 consecutive morning samples give the best results. The same applies to other thin body fluid samples.

As Mycobacterium tuberculosis is a slow-growing organism, it takes 6-12 weeks for primary isolation, which is a serious drawback. A growth made on the slide chamber can be seen under a microscope in 8-10 days. Radio-respirometry technology can give evidence of growth within 3-4 days. However, these methods need further evaluation.

Another good approach is to detect the antigens of tubercle bacilli in clinical specimens, e.g. CSF and urine, by very sensitive methods like ELISA or RIA. Detection of antibodies to antigens does not differentiate between the present and past infection. Cross reactivity with other Mycobacteria is also a problem.

Histological studies: Excisional biopsy or needle biopsy, being invasive procedures, should be employed only when the diagnosis cannot be made otherwise. Superficial nodes, like the cervical, and the excised material obtained during abdominal surgery are commonly used. The biopsy material from liver, pleura, lung or skin is occasionally utilized. Histopathology demonstrates a granuloma formation along with giant and epithelioid cells. Central caseation is more typical of tuberculosis. Rarely, Mycobacteria or acid-fact bacilli are demonstrated in the biopsied material. Simple granuloma

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To be taken mixed with water after meals.

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- **Safe for elderly patients.**
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NOMO is recommended for patients with depression associated with anxiety and also to treat enuresis in children over 6 years of age.

DOSAGE:

Adults: Initially, 1 tablet three times daily for a week which can be increased to two tablets three or four times daily. Treatment should be continued at least for 4 weeks for assessment of response. Dosage should be reduced gradually once satisfactory clinical improvement occurs.

Children between 6 to 10 years: 1 tablet at bedtime
above 10 years: 2 tablet at bedtime

COMPOSITION: Each tablet contains Imipramine hydrochloride 25 mg. and Diazepam 2 mg

AN EARLY START OF BETTER MOOD.

formation can be seen in many other chronic diseases and, therefore, an experienced pathologist should examine the material.

Biochemical tests: They are frequently done on body fluids[13] and sometimes the diagnosis largely depends on such findings.

Typical CSF findings in TB meningitis includes mild-to-moderate rise in proteins (100-500 mg%), normal glucose concentration and pleocytosis with lymphocytic preponderance. These findings are similar to those found in partially treated pyogenic meningitis. Therefore, further tests like the nitroblue tetrazolium (NBT) test and lactate dehydrogenase (LDH) concentration in the CSF are done. However, in most cases, the diagnosis becomes clear from the findings of history, examinations and other tests. In other cases, the course of the disease and the therapeutic response have to be evaluated.

Other body fluids like pleural, peritoneal and joint fluid are typically straw-coloured, and exudative in nature, showing high proteins (over 3g%) and lymphocytic preponderance in cells. These findings differentiate the tuberculous fluid from a transudate or a pyogenic exudate.

These findings, although characterstic, are not diagnostic of tuberculosis.

Haematological studies are nonspecific. Anaemia, relative lymphocytosis and raised erythrocyte sedimentation rate (ESR) are commonly seen. Young children below 3 years of age normally have a lymphocytosis of up to 65%, which should not be considered as indicative of chronic infection.

Scoring system[14]: As is obvious from the discussion so far, no test or finding is diagnostic, always positive or ideally suited in all cases.

For these reasons, a combination of various findings and tests is more useful for diagnosis than an isolated finding or test. Depending on the importance of a test or a finding and to provide uniformity and objectivity to the diagnostic process, various scoring systems have been evolved. One such modified scoring system is given below:

	Data	*Score*
1.	AFB demonstrated	+ 5
2	Tubercle in histology	+ 5
3(a)	Positive tuberculin test	+ 3
3(b)	Borderline tuberculin test	+ 2
4	Suggestive radiology	+ 3
5	Compatible physical examination	+ 3
6(a)	Known contact with an open case	+ 2
6(b)	Other contact with tuberculous case	+ 1
7	Nonspecific signs and symptoms	+ 1
8	Nonspecific X-rays	+ 1
9	Nonspecific granuloma	+ 1
10	Age less than 2 years	+ 1
11	Specific response to antitubercular therapy	+ 3

Interpretation of score:

Group I	1-2 points	TB unlikely
Group II	3-4 points	TB possible but further work up necessary
Group III	5-6 points	TB probable, therapy my be justified
Group IV	7 or more points	TB appears unquestionable.

Such scoring systems, however, do not stimulate one to localize the site of disease or to differentiate between primary and secondary tuberculosis. The scoring system should now also include scores for BCG test and for a positive scan.

Overdiagnosis of primary tuberculosis is a cause of concern. Not infrequently, children having palpable cervical lymph nodes, or repeated attacks of cough and colds, or those who are not thriving well, or whose skiagram of chest shows nonspecific changes like hilar prominence, are wrongly diagnosed and treated as primary complex. This is mostly due to a careless attitude, inadequate application of knowledge or undue apprehension on part of the treating doctor. The above-mentioned clinical situations are very common in our country, and more often these are due to reasons other than tuberculosis. Such cases should be properly investigated and tried on some scoring system. Overdiagnosis and unnecessary treatment are as hazardous and bad as are underdiagnosis and delay in therapy.

TREATMENT [15-21]

The treatment of tuberculosis has been revolutionised with the introduction of antitubercular drugs, which are the mainstay of

therapy now. Important advances are being made in drug regimes. Rest and good nutrition are important adjuvants. Other drugs and measures are utilized for symptomatic relief and for treatment of complications. Occassionally, surgical resection of the diseased organ or part is necessary for cure.

Antitubercular drug therapy: Former categorization of drugs as 'first line' and 'second line' or 'reserve' drugs has been replaced with that which depends on their mode and site of action.[22] Streptomycin, isoniazid, rifampicin and pyrazinamide are bactericidal, i.e. they kill the bacilli, while para-aminosalicylic acid (PAS), thiacetazone, ethambutol and cycloserine are bacteriostatic, i.e. they inhibit the multiplication of bacilli leaving the natural defences of body to kill and eliminate the bacilli. As the latter takes a longer time, longer therapy is required and, in addition, there is a risk or resistance developing and of reactivation tuberculosis.

Rifampicin and isoniazid are basic to any drug regime as these are effective bactericidal drugs for all populations of bacilli — extracellular, intracellular and those in the caseous material. Streptomycin and/or pyrazinamide are also used for their strong bactericidal action on extra-and intra-cellular organisms respectively. Bacteriostatic drugs had their role when bactericidal drugs like rifampicin and pyrazinamide were not available. These still find a place in the follow-up phase of therapy, specially because these are economical and less toxic.

Until now, 2 or 3 standard antitubercular drugs were used for 1½ years, or longer. Now, with the use of newer bactericidal drugs like rifampicin and pyrazinamide, bacilli are killed faster and the lesions are sterilized earlier. This is reducing the treatment period to around 6 to 9 months without increasing the risk of relapse or reactivation. This is called the 'short course chemotherapy' against the standard regime used so far. Short course chemotherapy has been used and evaluated in the adults for over a decade now and is considered to be an important milestone in the therapy of tuberculosis. It is now being evaluated in childhood tuberculosis. The results are encouraging and it appears that this form of therapy is here to stay. It is likely to replace the standard regime.

The older regime has been in use for over 3 decades with more or less satisfactory results. It consisted of two or three drugs to begin with. This usually meant streptomycin, isoniazid and PAS or

thiacetazone or ethambutol. Streptomycin is withdrawn after the first 2 or 3 months and two drugs are continued for 1 to 1½ years. Sometimes, another drug is added when streptomycim is withdrawn, thus continuing 3 drugs for another 3 to 6 months when one drug is withdrawn and the other two drugs are continued for a total of 1½ to 2 years. Various drug combinations are used but they include isoniazid which is usually continued for the full period of therapy.

The main disadvantage of this regime is the prolonged course. Patients or parents discontinued therapy when they felt better after a few months. This resulted in relapse or reactivation. Supervised intermittent, thrice-a-week regimes have been used in adults for improving compliance.

Short course chemotherapy: In this, two or more bactericidal drugs are used for a period of 6 months to 1 year. Sometimes the same combination of drugs is continued throughout the period of therapy. More commonly the therapy period is divided into two or three phases — the initial intensive phase and the subsequent follow-up phase(s). Another variation is to use drugs twice or thrice a week in the follow-up phase. This is designed to reduce the toxicity of drugs and to increase the compliance. Some short course chemotherapy regimes are presented in table II for clear understanding of the possible variations in the therapy.

Table II

Some short course chemotherapy regimes

(1) 6 HR	(8) 2SHRZ/4 HRZ
(2) 2 HR/4H_3 R_3	(9) 6 $S_2H_2R_2Z_2E_2$
(3) 12 HR	(10) 6 $S_2H_2R_2Z_2$
(4) 2 HRZ/4 HR	(11) 2 SHRZ/4 HRE/3 HE
(5) 2 HRZ/4H_2R_2	(12) 2 SH_2 RZ/4H_2RE/3H_2E
(6) 6 HRZE	(13) 2 RSHZ/6$H_2S_2Z_2$
(7) 2 SHRZ/4HR	(14) 1 RHSZ/5$H_2S_2Z_2$/2 HT

S = streptomycin, H = isoniazid, R = rifampicin,
Z = pyrazinamide, T = thiacetazone. E = ethambutol.

The number preceding the drug is the number of months for its daily administration, the continuation regime follows the stroke ( ). For intermittent regimes, the number of doses a week is shown by the subscript number. Thus 2 SH_2RZ/4 H_2RE 3H_2E means streptomycin, rifampicin & pyrazinamide daily and isoniazid twice a week for 2 months followed by rifampicin and ethambutol daily and isoniazid twice a week for next 4 months followed by daily ethambutol and twice a week isoniazid for next 3 months.

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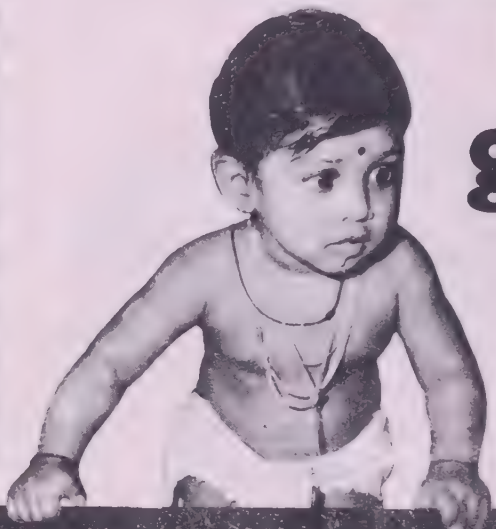

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Calcium Gluconate I.P.	0.25 g.
Vitamin A, I.P.	2500 I.U.
Cholecalciferol U.S.P. (Vitamin D_3)	200 I.U.
Ascorbic Acid I.P.	40 mg.
Cyanocobalamin I.P.	2.5 mcg.
Sodium Iron Edetate (equivalent to 5 mg. of elemental iron)	33.0 mg.

- **CALCINOL SYRUP-F supplies calcium and vitamins A & D especially for promoting growth.**
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The preferred regimes use 2, 3 or 4 drugs daily for 6 to 9 months, dividing the therapy period into the intensive phase and the follow-up phase, where necessary, depending on the severity of the disease. Four drugs are used only in the intensive phase.

Drug resistance is an important consideration in the chemotherapy of tuberculosis. The resistance may be primary or acquired. In primary resistance, the patient is infected with tubercle bacilli which are already resistant, while in the acquired resistance, the bacterial population is initially sensitive but the resistant mutants develop during the course of therapy. Acquired drug resistance is likely to develop during inadequate (e.g. mono-drug therapy), inappropriate or irregular treatment. About 2-3 bacilli per 100 million bacilli tend to develop resistance by mutation to one drug at a time.

The incidence of resistance to a particular drug is 10-20% in our country. However, it may be as high as 50% in some selected populations like chronic tuberculosis patients who have received irregular treatment over years. Resistance to every antitubercular drug is known. The choice of drugs should, therefore, depend on the source of infection, the likelihood of resistance in that particular case or in vitro sensitivity results.

Notes on Individual Antitubercular Drugs

Before using any drug one should be familiar with its pharmacology — mode of action, pharmacokinetics, dose and side effects. In general, when used in correct dose, the side effects of antitubercular drugs are uncommon and not serious. Life-threatening or disabling complications can occur due to indiscriminate use of a high dose for a prolonged period.

Isoniazid (INH): It's main action is on the extracellular, rapidly multiplying organisms, where it is bactericidal. It also acts, although

to a lesser degree, against the mycobacteria in the acidic intracellular environment and in the caseous material. It readily diffuses in all the body fluids including CSF, effusions and caseous material. It readily crosses the placenta and is secreted in breast milk, but there are no foetal or neonatal risks reported.

It is metabolised in the liver by acetylation and is excreted in urine. Some persons metabolise the drug fast (rapid acetylators) and others slowly (slow acetylators). However, this is clinically unimportant except when considering intermittent therapeutic regimes or when it is used in the presence of severe hepatic or renal failure.

The main untoward effect is its hepatotoxicity. Mild elevation of enzyme (SGPT) concentration does not warrant its discontinuation, but the development of jaundice or a 3-5 fold rise in the enzymes does. Serious hepatotoxicity occurs in less than 1% of cases. It develops within the first 10 weeks of therapy. The drug should be temporarily discontinued. Routine monitoring of liver enzymes is not required. Pyridoxine deficiency, leading to peripheral neuropathy, and phenytoin toxicity due to altered phenytoin metabolism are rarely seen.

The dose of INH is 10-20 mg/kg./day. When it is used with rifampicin, another hepatotoxic drug, the dose of either should be around 10 mg/kg to reduce the risk of hepatotoxicity.

Rifampicin: It is a potent bactericidal drug and is equally effective in the acidic and alkaline media and against intra-and extra-cellular and rapidly and slowly multiplying bacilli. The drug is well distributed in all the organs and body-fluids. It is metabolised in the liver. Because of its efficacy and wide penetration, it is as useful as isoniazid, but is costlier.

It's main toxicity is on the liver and is similar to isoniazid. Other side effects include allergic skin reactions, flu-like syndrome, GI upset, haemotoxicity, renal failure and neurological symptoms.

The dose is 10-20 mg/kg/day.

Streptomycin is given intramuscularly in a dosage of 20-40 mg kg and is used only in the initial phase of therapy. It is a potent bactericidal drug but acts only on the extracellular, rapidly multiplying organisms; it's main toxicity is ototoxicity, causing

deafness, vertigo and vomiting. Other effects include flushing, hypersensitivity and renal toxicity.

Pyrazinamide is a bactericidal drug with special action on the persistent population of bacilli in the acidic atmosphere of macrophages. It is an important addition to the short course chemotherapy. The daily dose is 20-30 mg/kg.

The main side effects are hepatitis and arthralgia. It should be avoided in hepatic failure and the dose should be adjusted in renal failure.

Ethambutol is a widely used bacteriostatic drug with a low toxicity. The daily dose is 15-25 mg/kg. The major toxicity is retrobulbar neuritis resulting in visual loss or defect in colour vision. Optic toxicity is reversed if therapy is stopped immediately. Rash and drug fever are unusual.

Management of Certain Clinical Situations

As has been described, the site and extent of lesions, the severity of disease, the clinical situation and the manifestations vary greatly. The response to therapy is also variable. Accordingly, therapy is to be tailored to suit the individual patient.

1. *Pregnancy and tuberculosis:* Pregnancy should be avoided in a tuberculous mother till she is fully treated. There are risks of premature and/or small-for-date birth, congenital tuberculosis, drug toxicity to mother and foetus, congenital malformation and increased neonatal morbidity and mortality. However, if pregnancy has occurred, the mother must be adequately treated . Isoniazid, rifampicin and ethambutol are safe, while streptomycin can cause vestibular damage in the foetus.

2. *Newborn baby of a tuberculous mother* also needs to be protected from acquiring tuberculosis postnatally. The best course is : (i) to treat the mother adequately and make her non-infectious; this will take about 3 months; (ii) to give primary chemo-prophylaxis to the baby with isoniazid, 10 mg/kg/day for 3-4 months when and as long as the mother is infectious; (iii) to give BCG vaccine to the baby at the age of 3 to 4 months after isoniazid has been stopped; (iv) to follow the child clinically and by Mantoux test and X-ray chest, if necessary, for about an year; it will be wrong to separate the baby

from the mother or to stop breast feeding; this may be disastrous in circumstances where the baby is, otherwise, at a greater risk of malnutrition, diarrhoea and infections.

3. *The recently infected child with a positive tuberculin test and a normal X-ray chest* symptomatic or asymptomatic (the uncomplicated primary infection) has so far been treated by most peadiatricians effectively by one drug, usually by isoniazid for 6 monhts to 1 year. Most continue to recommend this even now despite the theoretical consideration that at least two drugs should be used to prevent the emergence of resistance. It is argued that the bacterial load in these cases is low and that 80% of cases recover on their own and, therefore, it will be wrong to subject a large population of children to the toxicity of multiple antitubercular drugs. Further, the progression and the complications can be prevented by a single drug.

4. *Uncomplicated pulmonary primary complex* with hilar node enlargement and no involvement of adjacent structures is treated by some with one drug (secondary chemo-prophylaxis) and by others with two drugs for 6 months to 1 year. The decision will depend to some extent on the age of the child, his BCG status and on whether the child is symptomatic.

5. *A child with old healed tuberculosis* who develops temporary loss of resistance due to disease or drug is at a risk of reactvation or flaring up of tuberculosis. Those who develop measles or whooping cough should be given isoniazid for about 3 months. Those who are receiving cortisone or immunosuppressive therapy should be covered for that much period.

6. *Progressive pulmonary tuberculosis* in children is usually treated with 3 or more drugs. The duration of therapy and the choice and number of drugs depend on whether one uses the standard or the short course chemotherapy. These have been discussed earlier.

7. *Extrapulmonary tuberculosis:* The principles of chemotherapy are similar as have been discussed earlier. In fulminant infections like miliary tuberculosis and tuberculous meningitis, 3-4 drugs are used in the initial period and the total duration of therapy is also longer. Supportive therapy is very important.

In slowly progressive granulomatous forms of tuberculosis and in slowly enlarging tuberculomas, two drugs for 6 months to 1 year

may be sufficient. Same applies to allergic manifestations of tuberculosis which are comparatively immunocompetent states. In other forms of tuberculosis with intermediate severity and extent of disease like abdominal, renal and skeletal infections, the therapy is similarly varied. Intensive therapy is also required for tuberculosis of those organs or sites where loss of function may be badly incapacitating, e.g. spine and joints, eye, endocrines, CNS tuberculoma, middle ear etc.

The use of steroids in tuberculosis is necessary in certain clinical situations to reduce the oedema and toxaemia. These situations are meningitis, encephalopathy, miliary tuberculosis, endobronchial tuberculosis, massive pleural or pericardial effusion, mediastinal compression etc. It is given in doses of 1-2 mg/kg/day for 4-8 weeks and is then gradually tapered off. Its use may be harmful and is contraindicated in other situations.

The need for *surgical procedures* in the diagnosis and therapy of tuberculosis has decreased considerably. It still plays an important role in a number of circumstances, some of which are as follows:[23]

1. Lymphadenitis — (a) excisional biopsy, only when the diagnosis cannot be made otherwise, (b) abscess formation, (c) chronic sinus formation.,

2. Intrathoracic tuberculosis — (resection of a lobe or a lesion) — (a) unrelieved atelectasis complicated by repeated infections, (b) secondary bronchiectasis, (c) chronic fibrosed lung, (d) recurrent or persistent haemoptysis, (e) nodular or cavitary disease with resistant organisms or persistent positive sputum, (f) residual caseous nodules or fibro-caseous disease on the ground that the bacilli persist in these lesions and that there is a high risk of relapse, (g) constrictive pericarditis, (h) chronic encapsulated empyema, (i) bronchoscopy for ulcerative or obstructive endobronchial disease.

3. Renal tuberculosis — (a) hypertension due to a non-functioning kidney, (b) ureteric strictures and other structural deformities, (c) infection due to completely resistant orgnisms.

4. Abdominal tuberculosis — (a) peritoneoscopy for visualizing tubercles and strictures and for taking biopsy, (b) perforation of a tubercular ulcer, (c) obstruction by cicatricial stenosis of the bowel or by mesenteric shortening, (d) GI haemorrhage, (e) localized hypertrophic bowel disease, (f) localized abscess formation.

5. CNS tuberculosis : (a) obstructive hydrocephalus — shunt, (b) Pott's spine with pressure over cord or roots.

6. Drainage of cold abscess, ascitis, pleural effusion etc.

Surgery must always be done under cover of good drug therapy.

PREVENTION[24-29]

No country is free from tuberculosis. The annual incidence in Europe and North America is less than 100/ 1,00,000 population while it is 200, 250 and above 300 in South American, African and Asian countries respectively. It is among the ten leading causes of death in the world. About 40% of children get infected by the age of 12 in India. The incidence of fresh cases is about 3/ 1000 children per year. Approximate mortality in children due to tuberculosis is 60 per 1,00,000 pop./ year.

The main factors that contributed to the tremendous decline in the prevalence of tuberculosis in the developed countries are believed to be the improvements in socio-economic conditions, standards of living, nutrition, housing and clothing, public hygiene and the medical services. The countries and communities which have failed to achieve such improvements continue to have a high incidence of tuberculosis.

At the same time, these general measures alone do not suffice to prevent infection in an individual. Tuberculosis is prevalent in children of middle and upper social classes also in our country. This is due to the presence of a large pool of infective cases in the community. Tuberculosis control or prevention in an individual, therefore, needs the following additional measures:

BCG vaccination: It contains live attenuated bacilli. It induces hypersensitivity to tuberculoproteins as is demonstrated by a positive tuberculin test. BCG vaccination produces partial immunity against tuberculosis and so it reduces morbidity and mortality from tuberculosis in children. Even when the infection is acquired due to a higher infective load, the progression is controlled and the risk of serious complications like haematogenous spread tuberculous meningitis (TBM) is significantly reduced. For these reasons, the vaccine is recommended to be given to all children in our country.

The immunity and hypersensitivity produced by BCG is gradually lost with time and Mantoux test may become nagative in 2-

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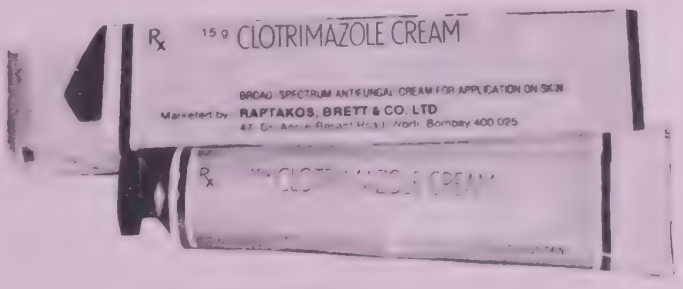

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5 years. It is, therefore, recommended that BCG be repeated at least once after 5 years.

BCG does not provide complete immunity and it alone is not sufficient to protect a child who is in contact with an infective case. Such children should be given additional *primary chemoprophylaxis* with isoniazid as has been discussed earlier. Usual BCG is isoniazide-sensitive and bacilli are killed by concurrent isoniazid therapy, so that the BCG does not 'take'. Therefore, BCG vaccination should be given after isoniazid has been stopped.

BCG is now recommended to be given at 3 months of age and repeated at 5 years. Formerly, it was given at birth. If a child has not received BCG up to 3 months of age the same can be given at any age thereafter, without prior Mantoux test, up to the age of 5 years. After 5 years of age, many would prefer to do Mantoux test and vaccinate only if it is negative.

0.1 ml. of recontituted solution of freshly prepared BCG vaccine is given in the deltoid area intradermally, raising a wheal of about 5 mm in diameter. This is absorbed in a few hours. A papule appears at this site in 3 weeks' time. This gradually enlarges, ulcerates and ultimately heals leaving a fine scar, in about 3 months' time. Once in a while this fails to heal or the enlarged axillary glands persist or soften and threaten to rupture. Such cases of BCG lymphadenitis can be successfully treated with isoniazid for 1-3 months. Progressive disease due to BCG is rarely seen. BCG vaccination is contraindicated in the immunocompromised child due to the fear of producing progressive disease.

Recently, the much publicised Chingleput report[29] on the non-efficacy of BCG vaccination in the prevention of tuberculosis has caused much public concern. Many reservations on the report have subsequently been expressed. The results are not applicable to the child population. Presently held views of paediatricians and other scientists in this regard have already been presented in the opening paragraph.

When a clinician detects primary infection in a child, he should also investigate other children of the family for detection of an early infection in them. Primary tuberculosis per se is not infective; no isolation is required and no chemoprophylaxis is necessary for their contacts. Efforts should, however, be made to detect the infectious

adult from whom the infection may have been acquired. He should be adequately treated and his contacts adequately protectd.

Mass screening of the adult population by X-ray and sputum examination is carried out by the public health authorities to detect infective cases. They are subsequently treated and madfe noninfective.

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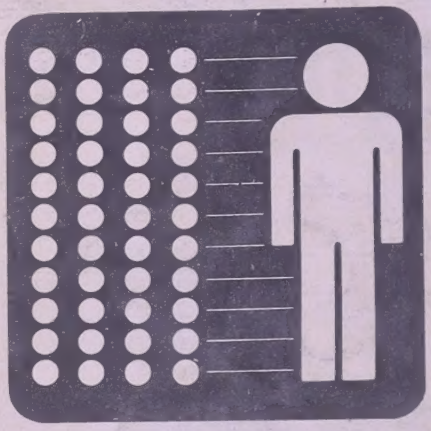

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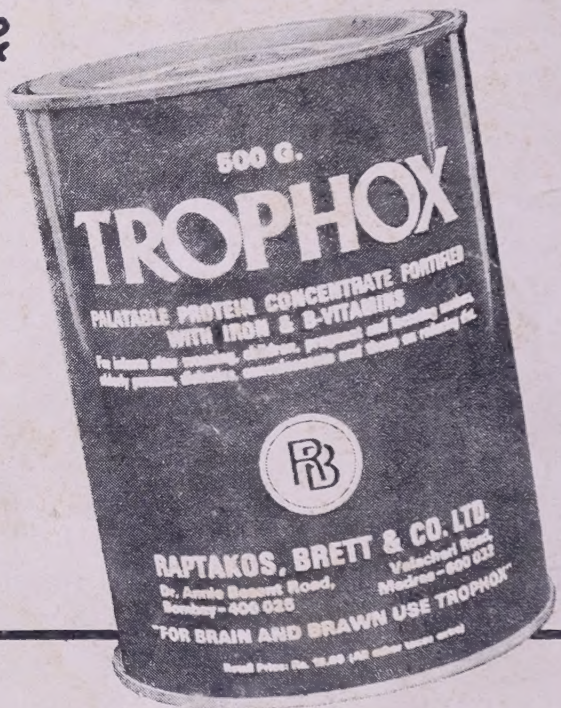
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